REMARKS/ARGUMENTS

Reconsideration of this application and entry of the foregoing amendments are respectfully requested.

Claim 89 has been amended so as to place the claim in independent form.

Prior to addressing the Examiner's specific concerns, Applicants offer the following comments regarding the meaning of the terms "network polymer" and "non-network polymer".

The IUPAC Gold Book defines a "network" in polymer chemistry as:

> A highly ramified macromolecular in which essentially each constitutional unit is connected to each other constitutional unit and to the macroscopic phase boundary by many permanent paths through the macromolecule, the number of such paths increasing with the average number of intervening bonds; the paths must be on average be co-extensive with the macromolecule.

The above definition can be found at *http://goldbook.iupac.org/N04112.html*.

Put simply, a "network polymer" is one in which it is possible to trace more than one path between each constitutional unit in the polymer. Cross-linked polymers are examples of networks.

A "non-network polymer" is one which does not meet the above quoted definition. A straight chain polymer is not a "network polymer" -- it is a "non-network polymer". Similarly a (non cross-linked) branched chain polymer is a "non-network polymer". Put simply, "non-network polymers" are such that it is only possible to go to-and-fro between any two constitutional units along a single path.

The Examiner provides some discussion of the term "non-network polymer" at the top of page 4 of the Office Action. The first paragraph on page 4 of the Action includes the following statement:

> Otherwise, polymers which have branched chains, ***or formed by monomers having more than two reacting moieties would inherently form network polymers (they are cross-linked)***.

(Emphasis added.)

Applicants agree with the bolded portion of the above but not with that portion of the statement relating to "branched chains". Nonetheless, it would appear that the Examiner is "comfortable" with the definition of network polymers. Basis for the Examiner's apparent confusion regarding the meaning of the term "non-network polymers" is not entirely understood and the Examiner is urged to give careful consideration to the following clarifying comments.

The polymers of McKeown (hereinafter "'587 reference"), upon which the claims are rejected under 35 USC 102/103, are **ALL network polymers**. In this regard, attention is directed to Formula (II) on page 2 of the '587 reference, which depicts a typical repeating unit of the network polymers of the reference, and also to the description in paragraph [0011] relating to the production of a 3-dimensional network. In Formula (II), there is depicted a porphyrinic ring system comprised of four pyrrole rings (5-membered, nitrogen-containing heterocyclic rings) linked together by the R groups and each having their nitrogen atom co-ordinated to a central metal ion. The R group can be nitrogen or carbon. When R is nitrogen, the porphyrinic ring system is a phthalocyanine (see formula at the top of page 4 of the '587 reference). When R is carbon, the porphyrinic ring system is porphyrin - see formula IIa on page 5 of the '587

reference. Irrespective of whether R is carbon or nitrogen, the polymers of the '567 reference are network polymers.

The fact that network polymers (in fact 3-dimensional network polymers) are produced in accordance with the disclosure of the '587 reference can be understood from a consideration of the "generalized" reaction shown in the lower half of the right hand column on page 5. There is a phthalonitrile compound which, "at each end", has a benzene ring with two cyano groups ortho to each other. The benzene rings are connected by a linker (L') which is such that the two benzene rings are orthogonal to each other. To achieve this "orthogonality", the linker L' can, for example, include a spiro-indane moiety of formula (V) (see right hand column on page 3 of the reference).

Applicants submit that, purely for the purposes of a simplistic explanation, it can be considered that the reaction proceeds in a number of stages.

In a first stage, four molecules of the phthalonitrile react with one metal ion such that (under the conditions of the reaction) a single molecule is initially produced. This single molecule comprises a porphyrinic ring connected to four residues of the phthalonitrile, each such residue having, at its "free" end, a benzene ring with two cyano groups ortho to each other. Thus, the molecule formed in this first stage has four pairs of ortho cyano groups, these groups being on benzene nuclei that are orthogonal to the planar porphyrinic ring due to the nature of the Linker'.

For the second stage of this simplified reaction, the ortho cyano groups on the benzene nucleus at each end of the first stage product react with three further phthalonitrile molecules to form a further porphyrinic ring. Thus (simplistically) one molecule of the first stage products reacts with 12 molecules of the phthalonitrile to

produce an (idealized) second stage product which is comprised of (i) the porphyrinic ring formed in the first stage, and (ii) four further porphyrinic rings formed in the second stage. The four porphyrinic rings (ii) created in the second stage are orthogonal to that (i) created in the first stage due to the nature of the linkers L'. Each porphyrinic ring (ii) created in the second stage is attached, on the one hand, to the porphyrinic ring (i) formed in the first stage and, on the other hand, to the residues of three of the phthalonitrile molecules introduced in the second stage reaction. Thus, at the end of the second stage, the molecule created has a total of 12 phthalonitrile residues, each terminated with a benzene ring having two cyano groups ortho to each other. In other words, there are now 12 pairs of ortho cyano groups.

In keeping with this simplified approach, a number of possibilities arise as the polymer continues to grow. The first is that a pair of ortho cyano groups on the growing polymer reacts with three further phthalonitrile molecules, exactly as described for the first and second stages. The second possibility is that pairs of ortho cyano groups on separate growing chains provide two of the four pairs required for phthalonitrile ring production (the other two pairs possibly being provided by phthalonitrile molecules). The third possibility is that two pairs of ortho cyano groups on the same polymer molecule (possibly one resulting from cross-linking, as mentioned previously) provide two of the four pairs required for phthalonitrile production. In this way, the whole reaction proceeds to produce a 3-dimensional network polymer which has microporisity due to the fact that adjacent porphyrinic residues are orthogonal to each other due to the nature of the linker groups L'.

In contrast to the '587 reference, the present invention relates to non-network polymers and the subject application discloses such non-network polymers. This will be readily appreciated from a review of the reaction schemes disclosed in the Examples of the present specification. Thus, for example, in Example 1 it can be seen that two molecules of compound (2) react with one molecule of compound (3) in an aromatic nucleophilic substitution reaction to produce a chain that cannot cross-link and become part of a network polymer because the chain can only continue left and right, as seen in Example 1. The same principle holds true for the other Examples in Applicants' specification.

In the second sentence on page 4 of the Office Action, the Examiner states that the term "'network polymer' is defined only by the porphyrin based structures in applicant's specification". Basis for this comment is not seen. The present specification does (on page 5) define what is meant by a "non-network" polymer and illustrates the distinction between such polymers and "network" polymers by reference to "the porphyrin-based materials disclosed in WO-A-2002/002838" (this WO publication is the "parent" of the '587 reference). It is not clear why the Examiner should seek to define the art-recognized term "network polymer" (see IUPAC definition above) by reference to a single sentence in the present specification and, apparently, conclude that while a "porphyrin based material" is a "network" polymer everything else is a "non-network" polymer. In so doing the Examiner is ignoring the "plain meaning" of the term "network polymer", that is, the ordinary and customary meaning given to that term by those skilled in the art (as evidenced by the IUPAC definition).

While it is to noted that the Examiner is prepared to conclude (as he does in the first paragraph on page 4 of the Official Action) that the porphyrin-based polymers are network polymers and, therefore, do not anticipate the claims, it is not clear why the Examiner goes on to state that "the reference does teach non-porphyrin based linkages as well". In this respect, the Examiner refers to paragraphs [0033] and [0050] of the '587 reference. The inference is that the disclosures in these paragraphs anticipate the claims. While the rejection based on anticipation is addressed below, Applicants point out that paragraph [0033] relates to "monomer units" that can be used for producing the polymers of the '587 reference. Paragraph [0050] also refers to monomer units as well as formation of phthalocyanine networks.

Turning now to the Examiner's specific concerns, claims 59-64, 66, 68, 70-72, 83, 85, 88 and 93-95 stand rejected under 35 USC 102(a) as anticipated by or, in the alternative, under 35 USC 103 as obvious over the '587 reference (or, alternatively, WO 03/000774). Withdrawal of the rejection is in order for the reasons that follow.

Applicants address first the rejection insofar as it is based on anticipation.

The claims relate to a microporous polymeric material which is a "non-network" polymer. The limitation to "non-network" polymers is:

(a) specifically included in independent claims 59 and 65, and claims depending therefrom, and

(b) is inherent in independent claims 88 and 89 in view of the way the polymer structure is presented in those claims.

Provided that the Examiner is properly interpreting the claims as being directed to what would be understood by one skilled in the art to be a "non-network" polymer,

then there is no anticipation by the '587 reference because (as discussed more fully above) the '587 reference only teaches the production of "network" polymers.

As noted above, the Examiner refers to paragraphs [0033] and [0050] of the '587 reference in contending that the present claims are anticipated. Paragraph [0033] of the reference is written in the context of the "network" polymers produced according to the'587 reference but refers specifically to a bridge ring compound (VIII) which incorporates three planar ring systems connected by a single, rigid linker (namely the bicyclo[2,2,2]octane ring). Instant claim 59 is drawn to a "microporous material" which is a non-network polymer. Compound (VIII) of the reference is not a microporous material. Additionally, compound (VIII) is not what would be understood by one skilled in the art as a "non-network polymer". If the Examiner takes a different view, he is requested to so indicate and to provide basis for his position.

Claim 59 requires that the polymer chain is comprised of repeating units bonded to each other with each such repeating unit including a first generally planar species and a rigid linker. Should the Examiner elect to maintain the rejection, he is requested to identify in compound (VIII) repeats of a planar ring system and a rigid linker. Compound (VIII) does include three planar ring systems but only a **single** rigid linker (the bicyclo[2,2,2]octane ring). Put another way, compound (VIII) does not have repeating points of contortion as required by claim 59.

The Examiner has equated present claim 63 with formula (IV) in the reference. It is the case that formula unit (IV) of the reference is used in polymers of the present invention but the similarity ends there. More specifically, claim 63 is directed to a "non-

network" polymer whereas formula (IV) in the '587 reference is included in network polymers.

The Examiner then refers to claim 64 and 89 – clarification of the reason for the reference to claim 89 is requested since claim 89 is indicated as being allowable. Claim 64 does show a unit that would be used in the polymers of the '587 reference. However, once again, claim 64 is directed to a "non-network" polymer and the reference relates to "network" polymers.

The Examiner then goes on to refer to claims 66 and 88 and points out that the repeating unit shown therein can be found in compound (XII) on page 6 of the reference. Furthermore, on page 3 of the Office Action, the Examiner shows compound (XII) of the reference on which he has included a "dotted box" to identify the repeating unit shown in present claims 66 and 88. Applicants make the following points.

Claim 66 is dependent from claim 59 and, therefore, has the following requirements:

(a) the polymer is a "non-network" polymer;

(b) the repeating units are bonded to each other; and

(c) each repeating unit is bonded predominately to two other such repeating units.

To the extent the Examiner may consider that claim 66 is anticipated by the "free" compound (XII), he is, respectfully, incorrect. Claim 66 is drawn to non-network polymers containing repeating units as defined. Compound (XII) is just that – a compound not a "non-network" polymer. Additionally compound (XII) (as the "free"

compound) contains only one unit as shown in the Examiner's dotted box: the unit does not repeat within the compound.

Once compound (XII) is incorporated in a polymer in accordance with the teachings of the '587 reference, then a "network" polymer is produced which does not anticipate the non-network polymer of claim 66. Additionally, as indicated under (b) above, claim 66 requires that the repeating units be connected to each other. This would not be the case for a polymer produced in accordance with the '587 reference using a compound of formula (XII). Further, a network polymer produced using a compound of formula (XII) does not meet requirement (c) above because the repeating unit would not be bonded predominately to two other such repeating units.

Turning now to claim 88, this clearly requires that the repeating units shown therein or bonded to each other: this is standard polymer nomenclature. For the reasons outlined above, this is the not the case in a network polymer obtained according to the '587 reference using a compound of formula (VIII).

As regards claims 67 and 69, the Examiner appears to misinterpret the wording of these claims.

Claim 67 (as currently presented) reads as follows:

> "A microporous material according to claim 64 wherein at least 70% by mole of the first planar species are connected by the rigid linkers to a maximum of two other said planar species".

Claim 69 is similar but specifies a minimum of 90% by mole.

It is important to note that claims 67 and 69, which depend from claim 59, are drawn to preferred characteristics for the "non-network" polymers of the invention.

Clearly, non-network polymers in accordance with claim 67 are such that at least 70% (by mole or equivalently by number) of the planar species are connected to a maximum of two other planar species. With a figure of 100% there is no branching. Claim 67 covers some branching at a planar species (such that each such species might be attached to three similar species) but, again, within the context of a non-network polymer. Similar comments apply to claim 69 in relation to its minimum of 90%.

The '587 reference discloses network polymers. These network polymers are such that (ideally) 100% of the planar species (the porphyrinic residues) are attached *via* the rigid linkers to three or (more ideally) four similar planar species. This results from the 3-dimensional network nature of the polymers of the reference. Therefore, claims 67 and 69 of the present application are clearly distinguished from the reference.

In rejecting claim 67, the Examiner appears to be reading claim 67 along the lines of:

> "A microporous material according to claim 64, wherein the organic macromolecules are comprised of at least 70% by mole of the repeating unit."

As the Examiner will appreciate, this is not the language of the claim as now presented.

For the reasons detailed above, Applicants submit that the '587 reference does not anticipate the current claims. The reference would also not have rendered the claimed invention obvious, contrary to the Examiner's statement on page 4 of the Office Action that

> "... the claims are still obvious to one of ordinary skill in the art, since the polymer monomers are capable of polymerising without having the porphyrin linkage. "

If the Examiner is suggesting that the '587 reference discloses molecules that (without modification) could react together to form polymers without porphyrin linkages, then Applicants respectfully submit he is in error. Reactant molecules disclosed in the '587 reference generally have terminal benzene nuclei with two cyano groups ortho to each other for use in forming a phthalocyanine ring (see above discussion). In this respect, attention is directed to, for example, the molecules shown on page 6 of the '587 reference. These molecules could not react together to produce polymers in accordance with the invention. Rather they react with a metal ion to product the phthalocyanine ring structure. An exception to this statement is the reaction scheme at the foot of page 7 of the '587 reference where the "large" molecule with the central phthalocyanine residue is linked to similar molecules using aromatic nucleophilic substitution chemistry not dissimilar to that employed in the present application (cf Example 1 thereof). This reaction (on page 7 of the '587 reference) leads to a "network" polymer. If the Examiner is of the view that it would have been obvious to modify the molecules shown at the foot of page 7 of the '587 reference by removing the phthalocyanine nucleus to end up with a non-network polymer in accordance with the present invention, he is requested to clearly indicate that is the case and to provide basis for his position.

Applicants respectfully submit there would have been no incentive to go from the disclosure in the cited '587 reference to the polymers of the present invention, not least because all of the emphasis in the reference is on network polymers containing linked porphyrinic residues.

As pointed out previously, prior to the present invention, the general trend in the art was for microporous organic polymeric materials to be network polymers. In the third paragraph on page 5 of the Office Action, the Examiner contends that there are many microporous structures that are not network polymers or cross-linked. So that Applicants will be properly positioned to respond, should the rejection be maintained, the Examiner is requested to further clarify what he intends by "microporous structures".

The Examiner is urged to give careful consideration to the foregoing comments. It is believed that, having done so, he will find withdrawal of the rejection to be in order and the same is requested.

Claim 88 stands objected to allegedly being a substantial duplicate of claim 66. The Examiner is respectfully requested to clarify the basis for his concern so that Applicants will be in a position to provide a full response.

This application is submitted to be in condition for allowance and a Notice to that effect is requested.

Respectfully submitted,

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